Addendum to

IPC-2510 GenCAM Editorial Comments

ENGINEERING INFORMATION SYSTEMS LABORATORY
eislab.gatech.edu
GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA, GA

INTRODUCTION

The Engineering Information Systems Laboratory submitted on July 8, 1998 a series of editorial comments concerning the Interim Final Draft of the IPC-2510 GenCAM standard. Subsequent discussions with learned colleagues, most notably Michael McLay at NIST, have highlighted some important additional points or clarifications, which we would like to draw the review committee's attention to.

CLARIFICATIONS

1.1 GenX Nomenclature

For brevity, we will use the mnemonic term 'GenX' to refer a GenCAM file in an XML-compliant format.

1.2 GenX and Engineering Service Bureau Data Flows

We illustrated in our original paper how GenCAM might be used in an Internet analysis context. Figure 2 in that paper (reproduced as Figure 1 below for convenience) illustrates how this scenario might occur. The engineer wishing to analyze a particular version of a design uploads the corresponding GenCAM file over the Internet to an Engineering Service Bureau (ESB).

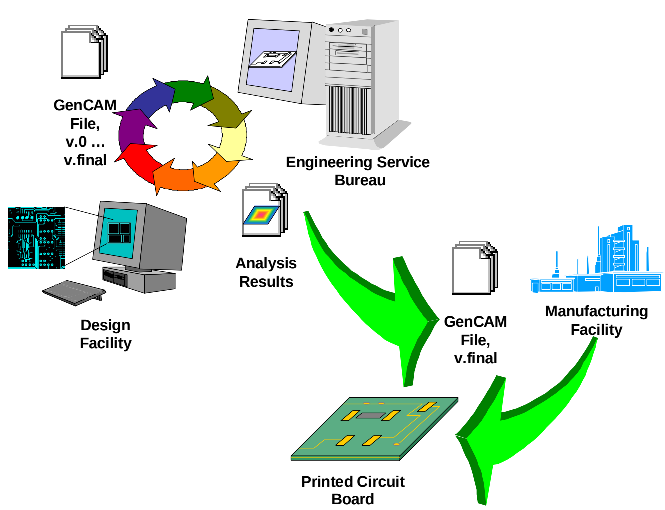

Figure 1: Prototype Through Production PWB Development With Engineering Service Bureau and GenCAM

Once the data file is resident on the machine conducting analysis, it goes through a simplification process we call 'idealization' to support analyses. In Figure 2 below, we show how only these simplified views of a detailed component are needed to support analysis. A detailed representation, shown on the left hand side, can be simplified to one or more idealized views, which neglect or simplify product features to make analysis possible. An interesting characteristic of idealizations, illustrated on the right hand side of Figure 2, is that they can be used in more than one analysis. For example, a 2D representation of a component might be used both in a cross sectional solder joint analysis and in an airflow analysis.

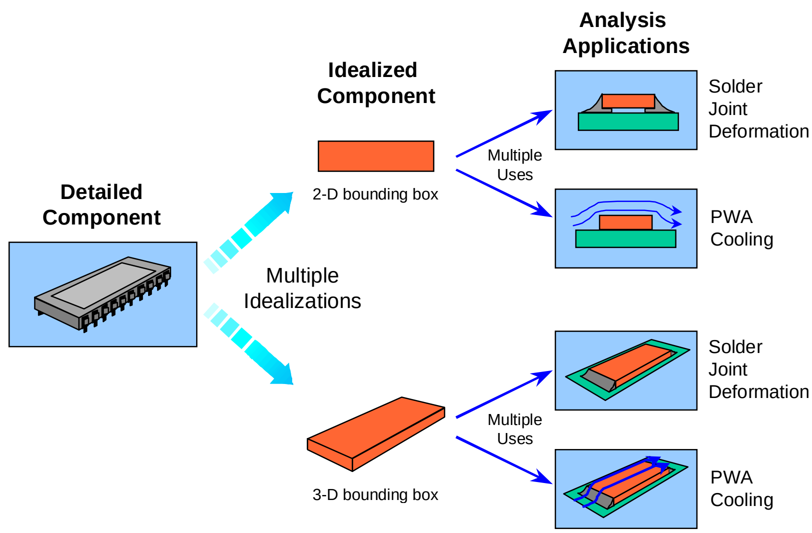

Figure 2: Product Information Is Idealized For Use In Analyses

In the TIGER project, the example analyses we provided (covering warpage, plated-through hole strains, and solder joint deformations) required only 33 KB of information from a 4.7 MB AP210 STEP file. Other applications of the same technique have shown similar reductions in the volume of information.

Section 2.2 of our original comments was intended to detail how a GenX file would take advantage of this natural compression of information in the analysis process by changing the point at which data is transferred to the Engineering Service Bureau. It was possible to conclude from the original description that an *analysis* capability was being processed on the client's computer. This was not our intended meaning. Rather, only an *idealization* capability is provided to the client's computer. The analyses themselves (most of which require expensive commercial analysis software) reside on the ESB's host computers. There may be a competitive incentive, in fact, for the ESB not to reveal all of the details of the actual analysis they carry out. (Consider what happens if a competing Service Bureau 'B' wishes to duplicate analysis capabilities developed by Service Bureau 'A' and they purchase a single use analysis!)

Figure 3 below illustrates this distinction. A GenX parser could be provided as a Javascript program (leftmost downward arrow), which operates on a GenX file in local storage (lower left corner). The analysis inputs, a result of parsing the GenX file, can be uploaded via an encrypted connection (upward arrow labeled https[1]) to the ESB server running the analysis tools of interest.[2] The analysis output is also provided to the client by secure connection (downward https arrow).

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[1] https refers to Secure Hypertext Transfer Protocol, a World Wide Web communication protocol utilizing Secure Socket Layer (SSL) encryption.

[2] Although Figure 3 illustrates a direct connection between the client and the analysis server, this is for clarity's sake only. A more realistic scenario would involve client-to-analysis server communication through the web server, possibly using a Common Gateway Interface or a CORBA wrapper.

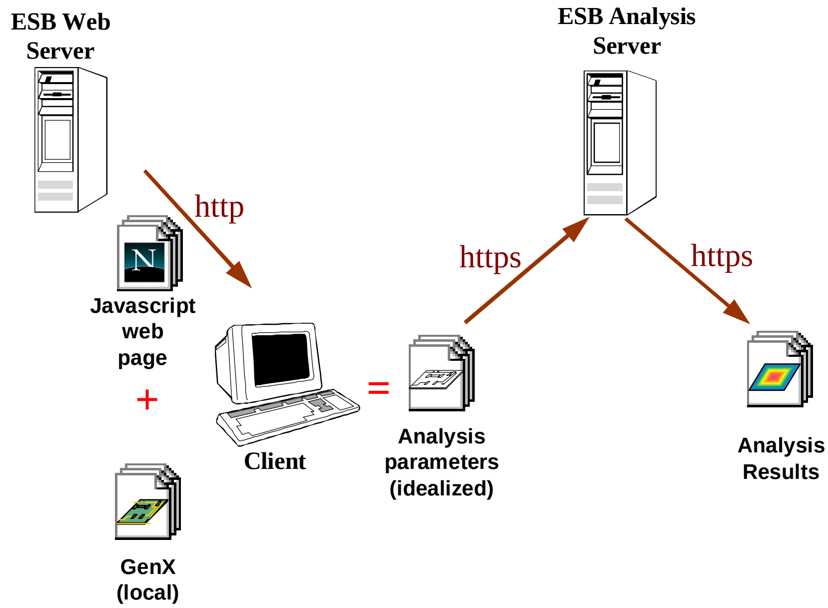

Figure 3: Using Idealized GenX Product Information For Web-based Analysis

Sending idealized product attributes has an additional advantage in terms of security – it is difficult to reverse the information discarded by the idealization process. For example, knowing the 2 dimensional bounding box enveloping a component does not in most cases give you any information about what the component does electrically.

XML is easy to parse, so the GenX format means providing this idealization capability and its attendant benefits is easily done.

1.3 GenX File Size

To illustrate the 'look and feel' of XML, we provided an example drawn from pg. 73 of the Interim Final Draft, Volume 1, of the IPC-2511 standard. This example mapped the following fragment of GenCAM syntax shown in Table 1 below to the XML shown in Table 2.

```
$PACKAGES
PACKAGE: "CAP_SUPPRESS_TYPE_24", "P34", "CERAMIC_DIP";
PINS: 24, "TH_RIBBON", 100, SIDE;
TARGET: "FIDUC_X", TARGETMARKER, "Padstack12", (0,0);
$ENDPACKAGES
```

Table 1: GenCAM Example From Page 73 IPC-2510 Interim Final Draft

```
<?xml version="1.0" standalone="yes" ?>
<PACKAGES>
<PACKAGE>
<PACKAGE_NAME> CAP_SUPPRESS_TYPE_24</PACKAGE_NAME>
<PRIMITIVE_REF>P34</PRIMITIVE_REF>
<PACKAGE_TYPE>CERAMIC_DIP</PACKAGE_TYPE>
<PINS>
<PIN_COUNT>24</PIN_COUNT>
<PIN_TYPE>TH_RIBBON</PIN_TYPE>
<PIN_PITCH>100</PIN_PITCH>
<PIN_EXIT>SIDE</PIN_EXIT>
</PINS>
<TARGET>
<TARGET_NAME>FIDUC_X</TARGET_NAME>
<TARGET_SURFACE_REFERENCE>TARGETMARKET</TARGET_SURFACE_REFERENCE>
<TARGET_REL_CENTER_POSITION>Padstack12< /TARGET_REL_CENTER_POSITION>
<TARGET_ROTATION>(0,0)</ TARGET_ROTATION>
</TARGET>
</PACKAGE>
</PACKAGES>
```

Table 2: XML Textual Form of PACKAGES Section Example

We noted that this XML mapping required approximately 3.4 times more storage than the GenCAM native format. This correlates with recent attempts to provide XML versions of STEP files.

The mapping we provided above is not the only mapping possible, however. Michael McLay of NIST suggested using attribute- value pairs to reduce the overall size of the file. Attribute value pairs (such as the HEIGHT = ”200” and WIDTH = “100” attribute pairs inside the IMG tag in HTML) provide the increased semantic readability of the original example while requiring much less space. The example mapping Michael authored (shown in Table 3 below) reduced the storage requirement to approximately half that required by the first XML mapping.

```
<?xml version=”1.0” standalone=”yes” ?>
<PACKAGES>
<PACKAGE NAME=”CAP_SUPPRESS_TYPE_24” PRIMITIVE_REF=”P34” TYPE=”CERAMIC_DIP”>
<PINS COUNT=”24” TYPE=”TH_RIBBON” PITCH=”100” EXIT=”SIDE”/>
<TARGET NAME=”FIDUC_X” SURFACE_REFERENCE=”TARGETMARKET”
REL_CENTER_POSITION=”Padstack12” ROTATION=”(0,0)”/>
</PACKAGE>
</PACKAGES>
```

Table 3: Improved XML Textual Form of PACKAGES Section Example

We concur with Michael that this mapping achieves the benefits of the XML meta-language without incurring high storage cost penalties, and we urge the Committee to consider this mapping as representative of GenX.